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Quantitative echotexture analysis of bovine ovarian follicles

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Abstract

Computer-assisted image analysis was used to evaluate ultrasound images of bovine ovarian follicles. The ovaries of 8 sexually mature heifers were examined daily by transrectal ultrasonography for 2 estrous cycles. Ultrasonographic examinations of the ovaries were then videotaped, and the dominant and subordinate follicles of successive waves were individually identified and monitored. Recorded images of the dominant anovulatory follicle of the first wave (n = 15) and the ovulatory follicle of the last wave (n = 15) of the estrous cycle were subsequently digitized for computer analysis of echotexture (mean pixel value and pixel heterogeneity). Regions of the image spanning the breadth of the follicle wall were selected, and image analysis revealed that mean pixel value of the dominant anovulatory follicle changed over time (P = 0.0005). Mean pixel value decreased (P = 0.0005) dramatically during the early static phase (Days 6 to 8, Day 0 = day of ovulation), increased (P = 0.0005) at the onset of the regressing phase (Day 12), and reached maximal levels (P = 0.0005) on Day 14. Similarly, image echotexture of the ovulatory follicle revealed a time-dependent effect (P = 0.0001) due to a rapid

the ovulatory follicle revealed a time-dependent effect (P = 0.0001) due to a rapid decrease in mean pixel values between 7 and 4 d before ovulation, followed by an increase until the day before ovulation. The echotexture of images of the follicular antrum were also evaluated and with regard to the dominant anovulatory follicle, a time-dependent effect was not detected for mean pixel value (P = 0.62) but was observed for pixel heterogeneity (P = 0.02). In addition, there was a positive correlation between mean pixel value and heterogeneity (r = 0.61, P = 0.0001). Heterogeneity initially decreased (P = 0.02) and remained low until the emergence of the second follicular wave (mean Day 9). Values subsequently increased and became variable during the late static and regressing phases (> Day 9). Mean pixel value of the antrum of the dominant ovulatory follicle increased (P = 0.0001) as the day of ovulation approached. Heterogeneity did not change (P = 0.14), nor was there any correlation between mean pixel value and heterogeneity for the antrum of the ovulatory follicle (r = 0.06, P = 0.49). We concluded that changes in echotexture (mean pixel value and heterogeneity) of bovine ovarian follicles assessed by computer analysis of ultrasound images were temporally related to functional status (i.e., anovulatory versus ovulatory; growing, static or regressing). The results were strongly supportive of the concept that ultrasonographically detected image attributes are a reflection of physiologic status.

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Keywords

cattle; follicle; image analysis; ultrasound; echotexture

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